# Idaho Transportation Department
# Solicitation #2011-01

## Title

Evaluating the Effectiveness of Winter Chemicals on Reducing Crashes in Idaho

## Problem Statement

In the mid-1990s, the Idaho Transportation Department (ITD) began researching winter highway maintenance alternatives that would improve on its traditional approach of removing snow accumulations and applying sanding material. Since then, ITD has supplemented those conventional methods with the application of chemical de-icers and anti-icers. These newer methods are more proactive or preventive than traditional "reactive" approaches and are proving to be more efficient and cost effective.

The chemicals most commonly used for de-icing and anti-icing in Idaho: are magnesium chloride, calcium chloride, and sodium chloride, with and without corrosion inhibitors. Magnesium chloride has been the product of choice for many years in the majority of areas services by ITD. Calcium chloride has been utilized in areas with colder ambient temperatures due to its lower working temperatures. In recent years, ITD has begun manufacturing and using sodium chloride for these activities. Although sodium chloride is not as affective at colder ambient temperatures as other products, it can be manufactured and distributed at a lower overall cost than either magnesium chloride or calcium chloride.

ITD needs to identify cost-effective ways to protect the driving public by reducing crashes, winter maintenance costs, and environmental effects of winter chemicals. The goal is provide guidance on the winter maintenance strategies/treatments/best practices that are most appropriate under specific roadway and climatic conditions within ITD districts. This will be identified by working with the diverse range of Idaho's roadways.

## Objectives

ITD, in the past, evaluated various products in terms of the effectiveness of each product for various ambient temperatures, procurement and manufacturing cost, the merits of each chemical and the net cost/mile to produce and distribute each product.

The objectives for this project are to:

1. Review and update costs associated with winter maintenance chemical usage.
2. Review and evaluate materials and historical use of products within Idaho and areas of similar climatic conditions.
3. Discuss recent research completed on various products.

4. Determine the effectiveness of each product as it relates to reducing crashes on Idaho highways. Analysis on Idaho data should include the years 1995 to 2010. Analysis of 2011 data should be included if available.
5. Develop a more effective winter maintenance strategy for Idaho.
6. Identify ways to increase safety at a lower cost while minimizing disruption to the traveling public.

## Research Proposed/Tasks

1. Perform a thorough literature review that is updated every 3 months during the project.
2. Review and summarize existing application data from Districts 1 and 5 Salt Brine operations.
3. Review and summarize existing application data from District 2 and 3 Magnesium Chloride operations.
4. Review and summarize the 2009-2010 Pilot MDSS Program from District 4.
5. Interview ITD staff to identify test road segments. Possibilities identified to date are:

   District 1: 90 Lookout Pass to Montana Stateline
   US-95
   SH-3
   District 2: US-95
   SH-3
   US-12
   District 4 SH-75
   District 5: I-15 MP 0-26
   I-15 MP 63-72
   I-15 MP 116-120

   Other road segments may be added as deemed necessary or appropriate.
6. Review and analyze historical data for each of the chosen segments, including:
   - Roadway design
   - Roadway category (rural/urban, arterial, etc)
   - Type of pavement and history of the pavement
   - ITS devices
   - Traffic flow data (AADT, vehicle classification if available, speed information, traffic movement)
   - Crash history
   - Level of service
7. Evaluate anti-icing, de-icing, solid and pre-wetting chemicals, including but not limited to: calcium chloride, magnesium chloride, potassium acetate, calcium magnesium, magnesium acetate, sodium chloride, urea, abrasives and sodium salts of carbolic acids. Any blends and combinations should be included. Both organic and inorganic substances should be reviewed. If the data is from lab testing the results must be replicated or reproducible in field conditions. Data reviewed should include , but is not be limited to the following:

- **Storage**: cost comparison for storage, special needs, storage shelf life, service life, difficulties, special loading/unloading instruction, safety/hazardous water concerns, quality control issues, stability, warranty requirements.
- **Handling Requirements**: hazardous waste?, spill concerns
- **Consistency:** from batch to batch, viscosity, specific gravity, grade consistency.
- **Meteorological Parameters**: air temperature, road temperature, wind speed, amount of precipitation, intensity, duration of storm, event time of day.
- **Traffic:** Influences, effectiveness of snow/all weather tires.
- **Environmental Issues:** Effects on the soil, vegetation, air, water, invertebrates, vertebrates, possible long-term effects, heavy metals.
- **Corrosion:** corrosiveness, inhibitors need for corrosion prevention, effects on private and commercial vehicles/equipment, effects on concrete/pavement/barriers/bridges.
- **Application Rates:** broken down by cost per mile and application amounts, timing issues related to application, reapplication rates.
- **Pavement Type**: wear performance, deterioration, staying capacity.
- **Precautions**: calibration, persistence, drifting, impurities, contamination concerns.
- **Skid Testing:** slipperiness, friction coefficient.
- **Physical/Chemical Properties**.
- **Freeze Point:** refreezing level/ freeze-thaw cycles, phase diagram.
- **Snow Removal/Dumping**: concerns, pollution.

8. Review and summarize weather/road conditions at a daily level for each road segment . This should include but not be limited to:
    - National Weather Service/NOAA information.
    - RWIS: review RWIS data on how best to use it the resource for winter maintenance issues.
9. Review and summarize historic crash and slide-off data for the identified routes between winter conditions and the other months of the year. Determine the effectiveness of each chemical at reducing accidents during winter months (either roadways covered with Snow/ice/slush, or the months of October to April). Data should include:
    - Location (route name, mile post, segment code).
    - Date and time of day.
    - Economic costs.
    - Property damage, cost, type of damage.
    - Severity (injuries/fatalities), costs associated.
    - Possible common factors associated with crashes.
    - Age of occupants.
    - Type of vehicle involved.

10. Develop screening criteria to eliminate non-applicable incidents (make sure incidents are related to surface condition, not geometry or human factors).
11. Develop cost per mile evaluations for routes selected and chemicals used at the state and district level. Compare Idaho's costs to that of other entities as to winter maintenance costs, including but not limited to:
    - Equipment: fuel costs, clean-up costs, engine hours, abrasive use, plowing time.
    - Road closure, detours.
    - Labor: wages, overtime/comp-time/standby costs, training costs.
    - Percentage of overall department budget and district budget.
12. Develop cost/benefit analysis for each chemical type in terms of cost versus accidents reduction.
13. Develop recommendations for chemical type based on route and weather conditions.
14. Description of the current practices and policies within the U.S. and Canada, and other locations if determined to be profitable.
15. Assist in developing a more effective winter maintenance strategy, including fine tuning site specific winter maintenance strategies.
16. Develop statistical assurances that observations did not occur due to random chance.
17. Identify ways to increase/improve communication with the public to increase awareness of winter crashes and the changes associated with the types of chemicals.
18. Identify the level of service needed to quickly restore road conditions by reducing the economic costs of road closures, road delays, and/or crashes. Determine the intangible benefits of decreasing crashes, delays, etc. Estimate socio/economic costs of alternate winter maintenance methods for the next ten years.
19. Identify ways to increase/improve communication with the public to increase awareness of winter crashes and the changes associated with the types of chemicals.

## Deliverables

1. Comprehensive literature search, with in the first 3 months, with periodic updates with each quarterly report.
2. Quarterly reports.
3. Develop a database that outlines data requirements for each chemical or compound/blend for various pavement and climatic condition. This will allow Districts to evaluate or ascertain the correct chemical for each roadway type and/or weather event. This should include any information on historical use within Idaho.
4. A best practices/recommendation listing for each chemical or blend type based on route and weather conditions. This will be free-standing from the database.
5. Develop a survey form for plow/maintenance operators to fill out – summarizing their observations concerning the performance of the chemicals.
6. Final report of the work efforts, findings, conclusion, cost versus benefit analyses, and recommendations.
7. Train district staff in data requirements, data standards and data entry to maintain a historical listing of applications.

8. Present findings and recommendations to ITD executive staff at the conclusion of the work efforts.
9. Develop a list of follow-up concerns to be reviewed yearly by ITD.

## ITD Project Involvement

The following data will be provided by ITD offices:

- Historical data on Winter Chemical Usage and Maintenance History.
- Historical Weather data from Department RWIS systems.
- Crash Data.
- Traffic Flow Data.
- Roadway Design History.

Additional data will be made available upon request by the investigators.

## Estimated Project Duration

18 months

## Project Budget Range

$90,000 - $120,000

## Proposal Format

All proposals must be formatted in accordance with the requirements specified in ***ITD's Request for Qualifications and Interest***, which is available at:

http://itd.idaho.gov/planning/research/proposals

## Proposal Deadline

Proposals must be received by the close of business **November 17, 2010**. Submit proposals by mail, e-mail, or facsimile to:

Idaho Transportation Department
Research Program, Planning Division
3311 W. State St.
P.O. Box 7129
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(208) 334-4432 (fax)